Karst Features and the Dissolution of Carbonate Rocks in Washington County

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March 2004

Over a long period of time limestone, and to a lesser extent dolomite, will gradually dissolve in the presence of ground water that was derived from precipitation. Carbon dioxide from the atmosphere and from the soil is incorporated into the precipitation as it changes from atmospheric moisture to ground water. Ground water containing dissolved carbon dioxide forms a mild acid, which can slowly dissolve alkaline materials. The alkaline carbonate bedrock units are affected by this process when the slightly acidic ground water moves through the units and is neutralized by the carbonate. A portion of the carbonate unit is dissolved in this neutralization process thus increasing the size of the fracture in which the water is flowing. As this process continues through time larger openings, solution features, form in the rock allowing for increased ground-water flow.

Many types of solution features can result from this process, some subtle and others quite large. The most common features develop along preexisting fractures, joints, and bedding planes, which represent the initial flow path of the water through the rock. Over time, a variety of larger features can develop leading to cave systems with sinkholes and deep valleys as surface expressions.

The near-surface bedrock aquifers in the Mississippian carbonates contain a highly variable fracture pattern, which greatly affects ground-water flow through the bedrock. Fractured rock represents one of the most complex types of hydrogeologic systems known. While regional ground-water flow can be very predictable, local flow can be highly varied in terms of both quantity and direction. Consequently, determining the local direction of ground-water flow in fractured bedrock at the scale of a specific site may require elaborate instrumentation, monitoring, and dye tracing.

The dissolution of carbonate rocks results in karst topography and other karst features. These include closed depressions on the land surface (e.g., sinkholes and sinking streams), caves, and underground drainage channels or conduits, some of which are several feet in height and width. Karst areas are extremely vulnerable to contamination from point sources (e.g., spills, leaking underground storage tanks, and individual household septic systems) and broad area contamination (e.g., road salts, vehicle emissions, pesticides, and fertilizers). The karst features of subterranean conduits or streams are in many cases connected for great distances. These connected conduits create a potential for widespread contamination downstream of a contaminant source. In places the flow rates can be similar to surface streams, with some contaminants flowing through the system rapidly (especially after a rain or snow-melt event), while in other parts of the system contaminants may be trapped in pools, sediments, or minor fractures for much longer periods of time.

Some of the larger karst features (sinkholes and sinking streams) in Washington County are shown on the map. These features are based on digital coverages from the Indiana Geological Survey. The closed depression coverage is based on U. S. Geological Survey hypsography (land surface contours) from 1:24,000 scale topographic maps. The overwhelming majority of these depressions are associated with karst development. The map also shows locations of wells in which the drillers reported caves, crevices, or mud-filled cavities.

The most extensive karst development in Washington County occurs in the outcrop area of the Blue River Group. The Sanders Group has a few isolated sinkholes, primarily on the uplands in central Washington County. The Blue River Group consists primarily of carbonates and some evaporite deposits. The majority of the sinkholes or depressions are on the Mitchell Plateau physiographic section, primarily in the western half of the county, which includes the towns of Livonia, Fredericksburg, Becks Mill, and Campbellsburg. Most of the Mitchell Plateau is underlain by Blue River Group carbonates. Typically, above the solid bedrock lie 20 to 50 feet of broken limestone and reddish-brown residual clay (terra rosa). However, broken limestone and residuum up to 80 feet thick have been reported in a few locations in Washington County. The areas of thickest clays tend to occur on the Mitchell Plateau. Additionally, water well records on file at the Division of Water indicate many caves or mud-filled cavities in this group. The height of the caves may be as much as 15 feet, but are typically 1 to 5 feet. Most of the water wells showing such cavities are also in the same general area as the surface karst features.

In Washington County, the West Baden Group occurs only on isolated ridge tops, primarily in the southwest part of the county. This group consists primarily of shale and sandstone, but has some limestone units that show karst development. The karst features in the West Baden Group are not as extensive or as connected as the features in the Blue River Group. The limestone formations are not as thick and are separated by shale or sandstone strata. Thus, fractures and joints are not as continuous.

The West Baden Group is not as vulnerable to widespread contamination as the Blue River Group. This is because the limestone units are relatively thin, they are separated by shale or sandstone, and the steep topography limits the size of areas contaminated.

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